US Army Corps of Engineers

MISCELLANEOUS PAPER CERC-91-3

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EAST PASS AND LUDINGTON SAND TRANSPORT DATA COLLECTION PROJECTS: DATA REPORT

by

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July 1991

Final Report

Approved For Public Release; Distribution Unlimited

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

Under Surf Zone Sediment Transport Processes
Work Unit 34321

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE
July 1991

3. REPORT TYPE AND DATES COVERED
Final report

4. TITLE AND SUBTITLE
East Pass and Ludington Sand Transport Data Collection Projects: Data Report

5. FUNDING NUMBERS
Work Unit 34321

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
USAE Waterways Experiment Station
Coastal Engineering Research Center
39C/ Halls Ferry Road
Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER
Miscellaneous Paper CERC-91-3

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
US Army Corps of Engineers
Washington, DC 20314-1000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This report is a compilation of data collected during two field data collection projects designed to measure the longshore sand transport rate. The field projects were conducted at East Pass, Florida, in September 1987 and Ludington, Michigan, in September 1988. Portable sand traps were used to make point measurements of longshore sand transport rates, with corresponding measurements of waves and currents. At Ludington, comparisons were made between the streamer traps and Optical Backscatter Sensors (OBS) under similar surf zone conditions. A complete listing of the sand transport rate, wave height and period, longshore current, water level, sand grain size data is presented for each field data collection project.

14. SUBJECT TERMS
See reverse.

15. NUMBER OF PAGES
50

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED		

14. (Continued).

East Pass Project, East Pass, Florida
Field experiment
Longshore sand transport
Ludington Project, Ludington, Michigan
Optical Backscatter Sensor
Streamer trap
Surf zone

PREFACE

The investigations described in this report were authorized as part of the Civil Works Research and Development Program by Headquarters, US Army Corps of Engineers (HQUSACE). This study was conducted under the Shore Protection and Restoration Program, Surf Zone Sediment Transport Processes Work Unit 34321, at the Coastal Engineering Research Center (CERC), US Army Engineer Waterways Experiment Station (WES). The HQUSACE Technical Monitors were Messrs. John H. Lockhart, Jr.; John G. Housley; James E. Crews; and Robert H. Campbell.

Data collection for the studies described herein was conducted by CERC during September 1987 (EAST PASS) and September 1988 (LUDINGTON); subsequent data analysis was conducted through December 1990. Dr. Nicholas C. Kraus, Research Division (RD), CERC, was Principal Investigator (PI) of Work Unit 34321 from its inception in September 1986 until September 1988; Ms. Kathryn J. Gingerich, formerly of the Coastal Processes Branch (CPB), RD, was PI from September 1988 until September 1989; and Ms. Julie Dean Rosati, CPB, RD, was PI from September 1989 through final preparation of this report.

Those assisting in data collection for both the EAS PASS and LUDINGTON studies included Messrs. C. Ray Townsend and Jeffery A. Se-ell, both of the Prototype Measurement and Analysis Branch, Engineering and Development Division (EDD), CERC, and Mr. William K. Halford, CPB. Mr. John Brandon and Ms. Brenda Dee Grimes, both formerly of the CPB, also participated in the EAST PASS study. Researchers directing part of the data collection at LUDINGTON included Dr. Reginald A. Beach, University of Washington; Mr. Edward B. Hands, Coastal Structures and Evaluation Branch, EDD; and Ms. Jane M. Smith, CPB. Others assisting in data collection at LUDINGTON included Dr. Mark R. Byrnes, formerly of the CPB; Mr. Alan Cialone, Coastal Oceanography Branch (COB), CERC; Mr. Christopher Frye, formerly of the CPB; Ms. Linda S. Lillycrop, COB; Ms. Heidi Pfeiffer, US Army Engineer District (USAED), Chicago; and Mr. Charles Thompson and Mrs. Vicki Thompson, USAED, Detroit.

This report was reviewed by Ms. Smith and Dr. James R. Tallent, CPB. Ms. Carolyn J. Dickson, CPB, prepared the computer-generated figures. The study was performed under the general administrative supervision of Dr. James R. Houston, Chief, CERC: Mr. Charles C. Calhoun, Jr., Assistant Chief, CERC;

Dr. C. Linwood Vincent, Program Manager, Shore Protection and Restoration Program, CERC; and Mr. H. Lee Butler, Chief, RD, CERC.

COL Larry B. Fulton, EN, was Commander and Director of WES during report preparation and publication. Dr. Robert W. Whalin was Technical Director.

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EAST PASS AND LUDINGTON SAND TRANSPORT DATA COLLECTION PROJECTS: DATA REPORT

PART I: INTRODUCTION

1. This report is a compilation of data collected during two field data collection projects performed to measure the longshore sand transport rate in the nearshore zone. The EAST PASS project, a limited deployment designed to test data collection equipment and procedures, was conducted in the Gulf of Mexico, at East Pass, Florida, on 29 September 1987. The EAST PASS project was conducted just south of Eglin Air Force Officer's Club on Santa Rosa Island (Figure 1). The LUDINGTON project was a moderate effort conducted in Lake Michigan, at Ludington State Park, Michigan, from 14 to 21 September 1988. The LUDINGTON project was conducted just south of the lighthouse at Ludington State Park (Figure 2). The objective of these data collection projects was to measure longshore sand transport rates together with the

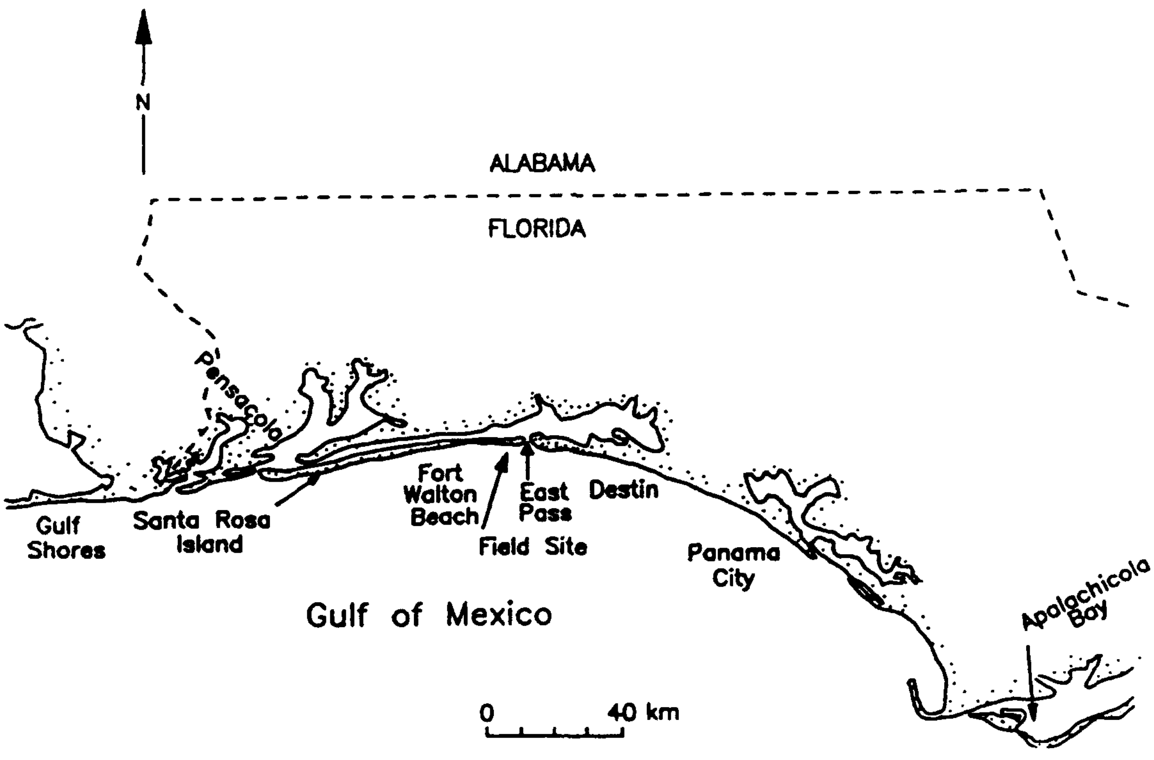

Figure 1. Location map for EAST PASS

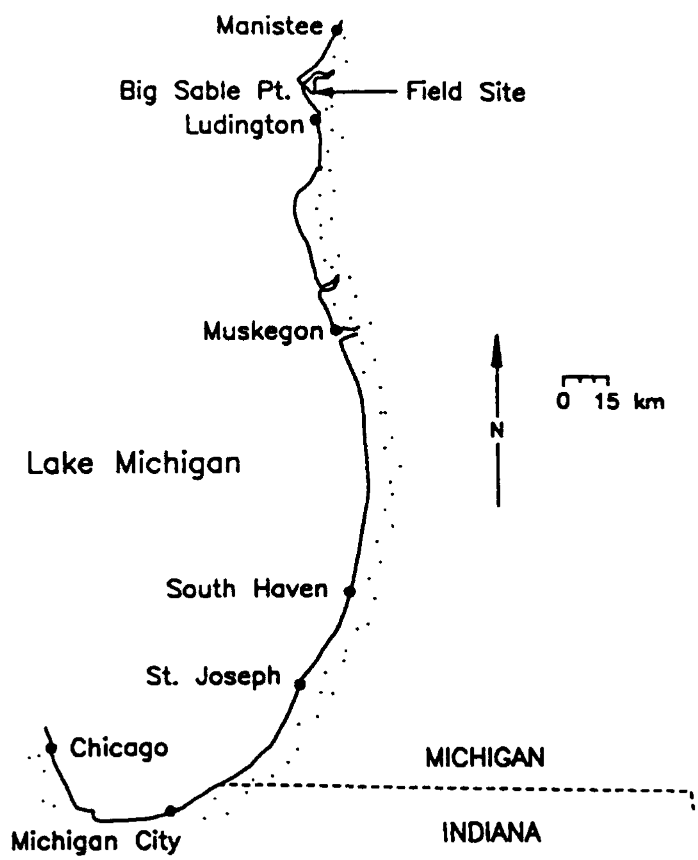

Figure 2. Location map for LUDINGTON

physical factors that produced and controlled the sand movement, including local waves, longshore current, water level, and nearshore bathymetry. This report documents these two projects, including basic sand transport data, current speeds, wave heights and periods, grain size distributions, water levels, and arrangement of instruments during data collection. Reference is also made to sources of related information.

2. This report completes documentation of the longshore sand transport data collection projects conducted by the research work unit "Surf Zone Sediment Transport Processes" (SZSTP) of the Shore Protection and Restoration Program, US Army Engineer Waterways Experiment Station, Coastal Engineering Research Center (CERC). Five longshore sand transport field data collection projects, including the two discussed herein, were conducted from September 1985 through June 1989 under SZSTP. The goal of this field data collection activity was to make comprehensive and high-quality measurements under a wide range of environmental conditions to investigate dependencies of the transport

rate on such factors as sediment grain size, beach slope, and wave and current forcing. Portable sand traps, used to measure longshore sand transport rates, were developed (Kraus 1987) and refined (Rosati and Kraus 1988, 1989, 1991) during the course of the data collection projects. The first two projects, called DUCK85 and SUPERDUCK, were major efforts held in September 1985 and 1986, respectively, at CERC's Field Research Facility in Duck, North Carolina. Documentation, data presentation, and reference to other sources of information for these experiments can be found in Kraus, Gingerich, and Rosati (1989) and Rosati, Gingerich, and Kraus (1990). The third and fourth projects are described herein; selected results of the LUDINGTON project are also given in Rosati et al. (1991). The fifth project was a minor effort that took place in the Pacific Ocean at the Scripps Institution of Oceanography, La Jolla, California, in June 1989. This project was unsuccessful due to unfavorable (confused) surf conditions and instrument fouling by kelp, and therefore will not be documented further.

3. An orientation to the study sites and description of the equipment and methodology used in the projects are given in Part II. Appendices A and B list the EAST PASS and LUDINGTON data, respectively. Appendix C lists the notation used in this report.

PART II: DESCRIPTION OF THE PROJECTS

4. This chapter provides a short explanation of data presented and notation used in Appendices A (EAST PASS) and B (LUDINGTON). For a more complete description of data collection procedures, data analysis, and example results from similar SZSTP field data collection projects, the reader is directed to Kraus (1987); Kraus, Gingerich, and Rosati (1989); and Rosati, Gingerich, and Kraus (1990).

5. The main objective of the SZSTP field data collection projects was to obtain point measurements of longshore sand transport, with simultaneous measurements of waves and currents. The streamer trap, a portable sand trapping apparatus consisting of a vertical array of mesh bags (streamers) mounted on a steel frame, was used to collect sand moving in the nearshore zone during a specified deployment interval (Figure 3). The 0.105-mm mesh bags collect material with nominal grain size greater than the mesh opening. The streamers are attached to the trap frame with stainless steel nozzles and numbered starting with 1 at the bottom. Three-inch Marsh-McBirney electromagnetic current meters, mounted on portable steel tripods, were positioned in close proximity to the traps (slightly downcurrent) (Tables A5 and B5). The x-axis points offshore (positive x-component indicates seaward-directed flow), and the y-axis points alongshore (positive y-component indicates Easterly flow for the EAST PASS data, and southerly flow for the LUDINGTON data) (see Figure 4). The lowered-numbered current meter is typically shoreward of the higher numbered meter. Pressure gages, also mounted on the tripods, were used to measure wave height and period (Tables A6 and B6). Wave and current data were recorded with a portable data logger powered by a generator.

6. Traps were typically deployed for 5- to 10-min intervals. It was determined that this time interval ensured a representative sampling, while preventing excessive scour at the base of the trap's bottom nozzle, which was flush with the bed. Run numbers are a concatenation of the date and local time; for example, Run 8709291125 began on 29 September 1987 at 11:25 am. At LUDINGTON, sand collected in each streamer was weighed in the drip-free wet condition (Table B2), which has been shown to be linearly related to the dry weight (Kraus and Nakashima 1986). Selected samples were taken back to the laboratory, and a relationship between the no-drip wet weight and dry weight

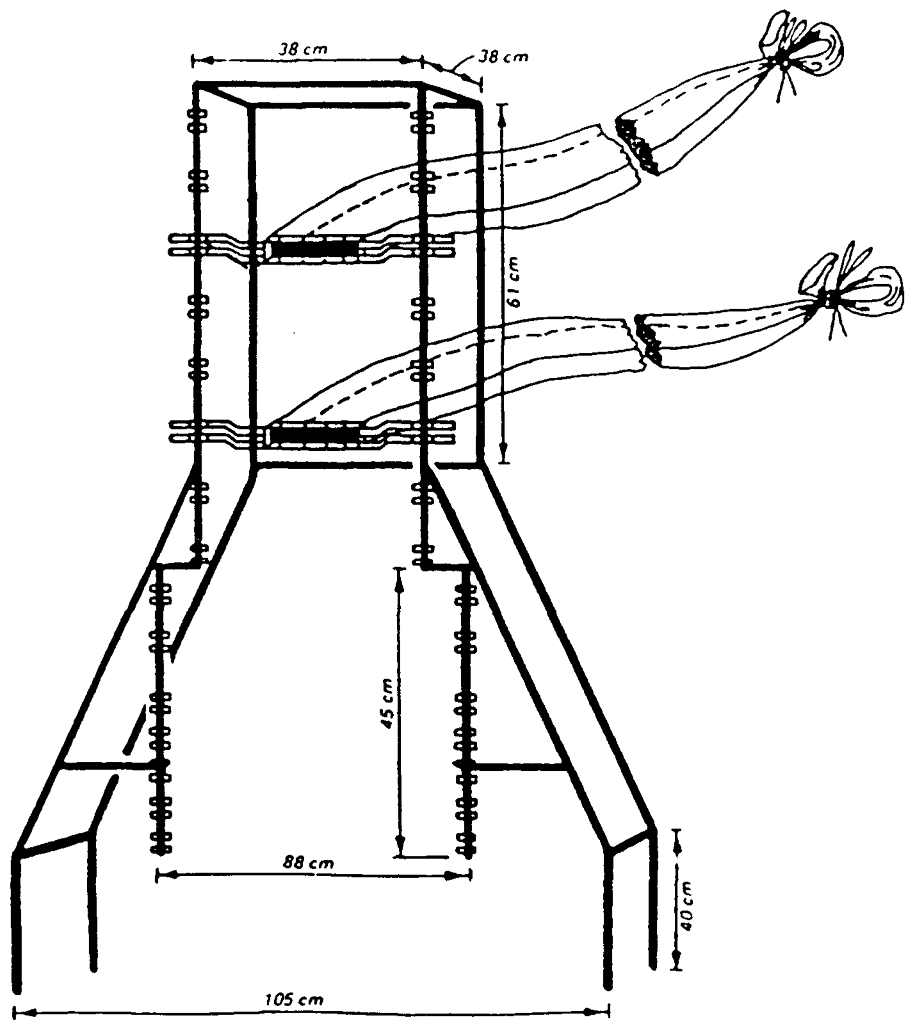

Figure 3. Streamer trap (from Kraus, Gingerich, and Rosati 1989)

determined. For the LUDINGTON samples, the dry weight was determined to be an average of 0.8 times the wet weight. Because of the small number of samples collected at EAST PASS, all were taken back to the laboratory and weighed in a dry state (Table A2). Listings of streamer elevations from seabed to mid-streamer for EAST PASS and LUDINGTON are given in Tables A3 and B3, respectively.

7. As indicated in Tables A1 and B1, four types of sand transport data collection runs were conducted: SSM, TSM, CON, and COM. The Spatial Sampling Method (SSM) consisted of positioning traps across the surf zone (typically out to the breaker line), so that the cross-shore distribution of the long-

shore sand transport rate was measured. Current meters and pressure gages were positioned downdrift of the trap line such that representative waves and currents were measured. An example SSM arrangement is shown in Figure 4.

8. The Temporal Sampling Method (TSM) consisted of repeatedly deploying one or two traps at positions in the nearshore zone to obtain the temporal change in longshore sand transport at a point. The current meters and pressure gages were placed slightly downdrift and inshore of the traps, as shown in a typical TSM setup (Figure 5).

9. Consistency (CON) testing consisted of deploying two traps in close proximity (approximately 1 m apart in both the on-offshore and longshore directions) to obtain a measure of trap reliability and reproducibility under similar wave and current conditions. Similar to the TSM runs, the current meters and pressure gages were positioned slightly downdrift and inshore of the traps (Figure 6).

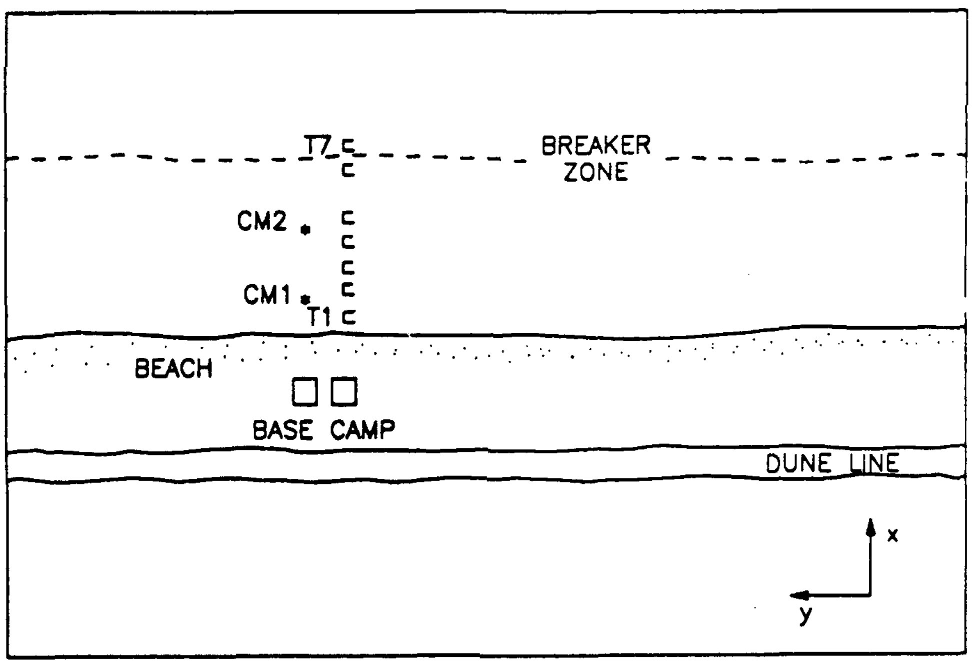

Figure 4. Typical SSM arrangement (adapted from Kraus, Gingerich, and Rosati 1989)

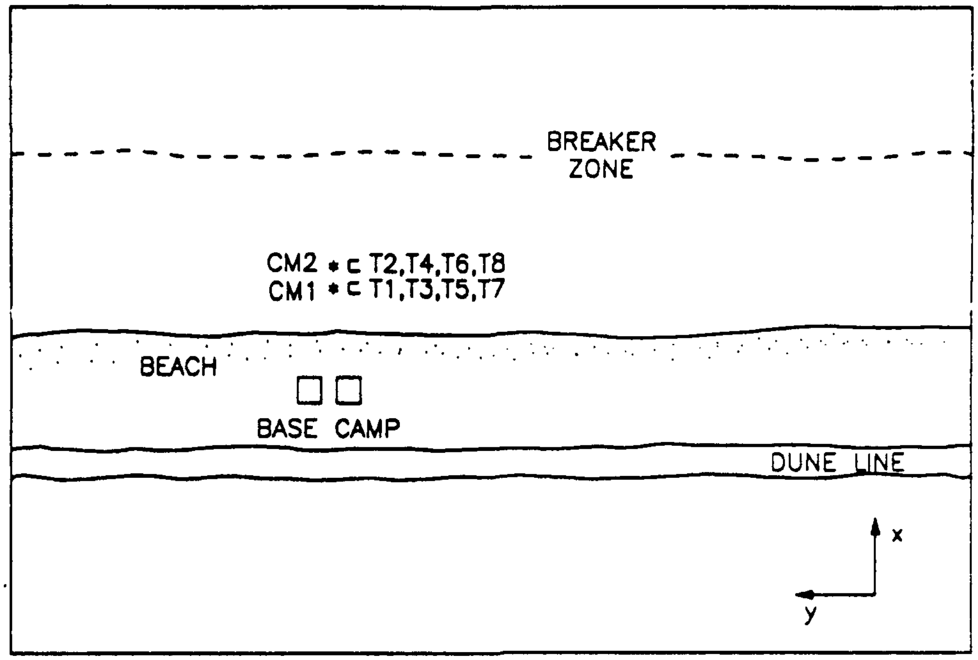

Figure 5. Typical TSM arrangement (adapted from Rosati, Gingerich, and Kraus 1990)

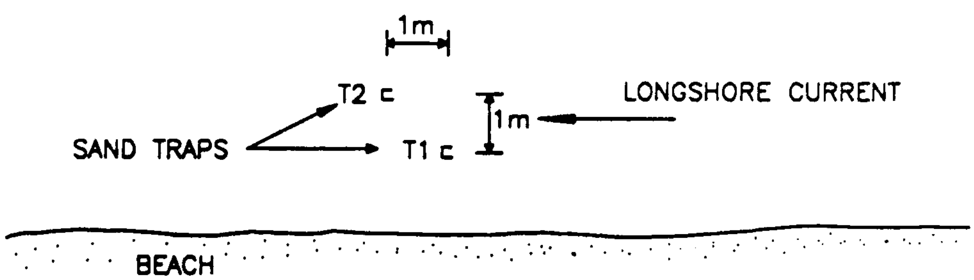

Figure 6. Typical CON arrangement (Rosati and Kraus 1989)

10. Comparison (COM) runs provided an evaluation of two different sand-transport measuring devices. A streamer trap and another measurement device (either another streamer trap with a different nozzle configuration, or an Optical Backscatter Sensor (OBS)) were positioned in very close proximity, and transport rates compared between devices. If two traps with different nozzle configurations were compared, traps were positioned similar to but slightly closer than in Figure 5. Comparisons between the OBS and streamer trap were conducted either with the OBS mounted on a pipe, positioned close to the trap, or with the OBS mounted directly on the trap frame.

11. Three types of streamer trap nozzles were intercompared at LUDINGTON: D85 (9 cm high by 15 cm wide), SD (2.5 cm high by 15 cm wide, with a 5.1 cm "hood"), and C (5.1 cm high by 5.1 cm wide, with a 5.1 cm hood). The D85 and SD nozzles were named for their use at the DUCK85 and SUPERDUCK field data collection projects, respectively; the C nozzle is abbreviated for its cubic shape. Each nozzle has a different sand-trapping efficiency, depending on its position in the water column, as indicated in Table 1. To obtain accurate estimates of the longshore sand transport rate, sand weights must be divided by the appropriate value of sand-trapping efficiency (Rosati and Kraus 1989). Sand weights presented in Tables A2 and B2 have not been adjusted for nozzle efficiency. Selected samples saved from traps at EAST PASS and LUDINGTON were analyzed to give grain size statistics (Tables A8 and B8, respectively).

12. Bathymetry in the vicinity of the experiment was measured by standard rod-and-level surveys (Tables A7 and B7). Water depths during EAST PASS were visually approximated using the water level on the trap frame (Table

Table 1
Values of Sand-Trapping Efficiency for Various Nozzles
(adapted from Rosati and Kraus 1989)

Nozzle	On-Bed (Streamer 1)	Off-Bed (All Other Streamers)
D85	0.13	0.92
SD	0.68	1.02
C	1.00	1.00

A4). Water level information during the LUDINGTON experiment was obtained from a National Oceanic and Atmospheric Administration (NOAA) gage at LUDINGTON, and is given in meters relative to the International Great Lakes Datum (IGLD) (175.8 m IGLD is referred to as Low Water Datum (LWD)).

13. The data presented herein and in companion reports describing the DUCK85 (Kraus, Gingerich, and Rosati 1989) and SUPERDUCK (Rosati, Gingerich, and Kraus 1990) field data collection projects are intended to provide detailed information of nearshore sand transport as a function of waves and currents. Use of the streamer trap during these field data collection projects facilitated measurements of the vertical distribution of sand transport; across-shore distributions were measured during SSM deployments; and TSM runs allowed the time variation of sand transport at (a) point(s) in the nearshore zone to be evaluated. These measurements together present a two-dimensional representation of nearshore sand transport as it varies through time, and with waves and currents. These data are intended to improve empirical and numerical predictive tools for longshore sand transport, nearshore waves, and nearshore currents. In particular, analytical expressions for vertical, across-shore, and temporal distributions of longshore transport as a function of waves and currents will be incorporated into two- and three-dimensional numerical models of beach change.

14. Future research efforts will be focussed on detailed measurements of surf zone processes in a large laboratory basin at near-prototype scale. The laboratory work will extend the previous field studies, allowing more detailed measurements of processes at a lower cost than would be possible in the field. Additional intercomparison between sediment transport measurement apparatus in the field is recommended, but is not planned at present.

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APPENDIX A: EAST PASS, FLORIDA DATA

Table A1

EAST PASS: Times and Locations of Instrument Deployments

Run ID No.	Instrument	Time CST[1]	Type of Run[2]	Description of Deployment Location
8709291125	T1	1125-1130	TSM	Surf zone, between CM1 and CM2
	T2	1130-1135		
	T3	1135-1140		
	T4	1140-1145		
	CM1, PG1	1125-1145		6 m seaward of traps
	CM2, PG2	1125-1145		6 m shoreward of traps
8709291524	T1	1524-1529	TSM	Surf zone, between CM1 and CM2
	T2	1529-1534		
	T3	1534-1539		
	T4	1539-1544		
	CM1, PG1	1524-1544		3 m seaward of traps
	CM2, PG2	1524-1544		3 m shoreward of traps

[1] CST = Central Standard Time.
[2] Notation is defined in Appendix C.

Table A2

EAST PASS: Sand Dry Weights, g

Trap No.	Streamer Number[1] 1	2	3	4	5	6
			Run 8709291125			
1	9.5	9.5	3.6	1.3	0.5	0.3
2	24.4	4.9	4.3	7.5	2.1	0.3
3	15.6	25.5	11.8	8.3	0.2	0.0
4	148.8	62.3	34.7	32.0	16.7	0.0
			Run 8709291524			
1	87.1	49.6	44.4	28.8	11.5	2.4
2	195.5	32.3	16.1	15.1	6.3	0.0
3	61.0	40.3	32.7	21.2	3.3	0.7
4	27.9	19.7	13.6	15.2	8.1	0.0

[1] All traps used SD nozzles.

Table A3

EAST PASS: Streamer Elevations from Sea Bed to Mid-Streamer, m

Trap No.	Streamer Number 1	2	3	4	5	6
			Run 8709291125			
1	0.013	0.083	0.165	0.343	0.533	0.730
2	0.013	0.089	0.191	0.343	0.546	0.743
3	0.013	0.083	0.216	0.375	0.622	0.927
4	0.013	0.089	0.229	0.413	0.546	0.851
			Run 8709291524			
1	0.013	0.076	0.171	0.343	0.546	0.724
2	0.013	0.089	0.190	0.343	0.546	0.743
3	0.013	0.095	0.190	0.368	0.546	0.698
4	0.013	0.121	0.216	0.394	0.578	0.781

Table A4

EAST PASS: Water Levels[1]

Time Interval CST	Water Depth m
Run 8709291125	
1125-1130	0.34
1130-1135	0.45
1135-1140	0.50
1140-1145	0.48
Run 8709291524	
1524-1529	0.55
1529-1534	0.55
1534-1539	0.55
1539-1544	0.58

[1] Water level visually approximated using water surface on trap frame.

Table A5

EAST PASS: Current Meter Data

Time CST[2]	Current Speed, cm/sec							
	CY1[1]		CX1		CY2		CX2	
	Mean	σ_v	Mean	σ_v	Mean	σ_v	Mean	σ_v
				Run 8709291125				
1125-1130	-27.1	11.0	4.5	18.6	-26.7	19.4	14.9	34.5
1130-1135	-23.3	12.3	-0.3	18.9	-33.7	21.2	12.0	36.4
1135-1140	-31.3	11.5	4.4	18.4	-35.6	20.0	19.6	34.2
1140-1145	-34.9	11.0	[illegible] 0	20.1	-40.7	20.7	10.7	36.6
				Run 8709291524				
1524-1529	-42.2	11.6	6.6	20.7	-36.4	17.4	7.5	32.3
1529-1534	-42.4	12.3	8.1	20.8	-38.5	17.8	10.7	32.4
1534-1539	-37.0	11.5	1.9	21.5	-31.4	21.5	5.2	34.2
1539-1544	-38.2	11.4	5.8	20.7	-32.4	18.4	8.9	32.7

[1] Notation is defined in Appendix C.
[2] Central Standard Time.

Table A6

EAST PASS: Wave Data

Run ID	Gage No.	Averaging Interval CST[2]	H_{mo}[1] m	T_p sec
8709291125	1	1125 - 1145	0.34	5.9
	2	1125 - 1145	0.16	5.9
8709191524	1	1524 - 1544	0.29	4.9
	2	1524 - 1544	0.19	4.9

[1] Notation is defined in Appendix C.
[2] Central Standard Time.

Table A7

EAST PASS: Profile Survey Data

Profile Line No.	Distance from Baseline, m	Elevation, m MLW[1]
	Run 8709291125[2]	
2	0.0	1.27
	3.0	1.29
	6.1	1.33
	9.1	1.27
	12.2	1.13
	15.2	0.74
	18.3	0.47
	21.3	0.32
	24.4	0.07
	27.4	-0.22
	30.5	-0.40
	33.5	-0.50
	36.6	-0.52
	39.6	-0.62
	42.7	-0.58
	45.7	-0.53
	48.8	-0.50
	51.8	-0.67
	54.9	-0.77
	57.9	-0.90
	61.0	-0.97
	64.0	-1.00
3	0.0	1.20
	3.0	1.22
	6.1	1.21
	9.1	1.23
	12.2	1.07
	15.2	0.96
	18.3	0.43
	21.3	0.24
	24.4	-0.13
	27.4	-0.39

(Continued)

[1] MLW = Mean Low Water.
[2] Traps located between profile lines 2 and 3; profile lines 2 and 3 were 20 ft apart.

(Sheet 1 of 2)

Table A7 (Concluded)

Profile Line No.	Distance from Baseline, m	Elevation m MLW
	30.5	-0.51
	33.5	-0.62
	36.6	-0.65
	39.6	-0.58
	42.7	-0.61
	45.7	-0.56
	48.8	-0.68
	51.8	-0.81
	54.9	-0.82
	57.9	-0.96
	61.0	-1.07
	64.0	-1.12
	Run 8709291524[1]	
1A	0.0	1.38
	3.0	1.38
	6.1	1.39
	9.1	1.23
	12.2	0.86
	15.2	0.56
	18.3	0.00
	21.3	-0.07
	24.4	-0.33
	27.4	-0.43
	30.5	-0.50
	33.5	-0.51
	36.6	-0.52
	39.6	-0.42
	42.7	-0.50
	45.7	-0.79
	48.8	-0.95
	51.8	-1.00
	54.9	-1.06

(Sheet 2 of 2)

[1] Traps located at profile line 1A; profile line 1A was midway between profile lines 2 and 3.

Table A8

EAST PASS: Grain Size Statistics

Run ID and Trap No.	Streamer No.	Moment Statistics: First PHI	Second PHI	Third	Fourth	Folk Inclusive Graphic Statistics: Median PHI	Mean PHI	Standard Deviation PHI	Skewness	Kurtosis
8709291125										
2	1	1.95	0.32	-1.15	10.54	1.96	1.95	0.29	-0.07	1.12
	5	1.82	0.35	-0.59	4.98	1.85	1.84	0.34	-0.11	1.21
8709291524										
4	1	1.83	0.34	-1.02	7.97	1.86	1.84	0.32	-0.11	1.19
	5	1.96	0.35	-2.79	25.55	1.98	1.97	0.27	-0.02	1.07

APPENDIX B: LUDINGTON, MICHIGAN DATA

Table B1

LUDINGTON: Times and Locations of Instrument Deployments

Run ID No.	Instrument	Time EDST[1]	Type of Run	Description of Deployment Location
8809141550	T1[2]	1550-1555	Practice	Surf zone
	T2	↓		3 m lakeward of T1
	CM2, PG2[2]	↓		Downdrift and opposite T1
	CM3, PG3	↓		Downdrift and opposite T2
8809141610	T3[2]	1610-1615	Practice	Surf zone
	CM2, PG2[2]	↓		Downdrift and opposite T3
	CM3, PG3[2]	↓		Downdrift and opposite T3
8809161625	T1[2]	1625-1630	CON	Surf zone
	T2	1625-1630		1 m lakeward of T1
	T3[2]	1630-1635		Surf zone
	T4	1630-1635		1 m lakeward of T3
	T5[2]	1635-1640		Surf zone
	T6	1635-1640		1 m lakeward of T5
	T7[2]	1640-1645		Surf zone
	CM2, PG2	1625-1640		Downdrift and opposite T2, T4, T6
	CM3, PG3[2]	↓		Downdrift and opposite T1, T3, T5, T7
	PG1	↓		15 m updrift and in line with CM2, PG2
8809161725	T1[2]	1725-1730	SSM	26.9 m from baseline
	T2[2]	↓		28.1 m from baseline
	T3	↓		30.0 m from baseline
	T5	↓		31.5 m from baseline
	CM2, PG2	↓		32.3 m from baseline
	CM3, PG3	↓		30.7 m from baseline
8809171130	T1[2]	1130-1135	SSM	29.2 m from baseline
	T2[2]	↓		30.0 m from baseline
	T3[2]	↓		33.0 m from baseline
	T4	↓		39.1 m from baseline
	T5	↓		45.2 m from baseline
	T6	↓		57.4 m from baseline
	T7	↓		87.9 m from baseline
	CM2, PG2	↓		39.1 m from baseline
	CM3, PG3	↓		45.2 m from baseline
	PG1[2]	↓		33.0 m from baseline

(Continued) (Sheet 1 of 4)

[1] EDST = Eastern Daylight Savings Time.
[2] Positioned in surf zone.

Table B1 (Continued)

Run ID No.	Instrument	Time EDST	Type of Run	Description of Deployment Location
8809171521	T1[1]	1521-1526	SSM	61.2 m from baseline
	T2[1]			65.8 m from baseline
	T3[1]			74.3 m from baseline
	T4			84.5 m from baseline
	T5			90.5 m from baseline
	T6			97.7 m from baseline
	T7			112.7 m from baseline
	CM2, PG2			84.5 m from baseline
	CM3, PG3			97.7 m from baseline
	PG1[1]			65.8 m from baseline
8809181525	T1	1525-1530	TSM (2 pair)	3 m lakeward of T2
	T2[1]	1525-1530		At breakers
	T3	1530-1535		3 m lakeward of T4
	T4[1]	1530-1535		At breakers
	T5	1535-1540		3 m lakeward of T6
	T6[1]	1535-1540		At breakers
	T7	1540-1545		3 m lakeward of breakers
	T8	1545-1550		3 m lakeward of breakers
	CM2, PG2[1]	1525-1550[2]		Downdrift and opposite T2, T4, T6
	CM3, PG3	[2]		Downdrift and opposite T1, T3, T5, T7, T8
	OBS			Updrift and opposite T1, T3, T5, T7, T8
	PG1	1525-1545[2]		13 m updrift and midway between PG2 and PG3
8809181645	T1	1645-1650	TSM (2 pair)	3 m lakeward of T2
	T2[1]	1645-1650		At breakers
	T3	1650-1655		3 m lakeward of T4
	T4[1]	1650-1655		At breakers
	T5	1655-1700		3 m lakeward of T6
	T6[1]	1655-1700		At breakers
	T7	1700-1705		3 m lakeward of T8
	T8[1]	1700-1705		At breakers
	CM2, PG2[1]	1650-1715[2]		Downdrift and opposite T2, T4, T6, T8
	CM3, PG3	1650-1715[2]		Downdrift and opposite T1, T3, T5, T7
	OBS	1645-1705		Updrift and opposite T1, T3, T5, T7
	PG1	1650-1709		13 m updrift and midway between PG2 and PG3

[1] Positioned in surf zone.
[2] Some gaps exist in data set.

(Continued)

(Sheet 2 of 4)

Table B1 (Continued)

Run ID No.	Instrument	Time EDST	Type of Run	Description of Deployment Location
8809191325	T1[1]	1325-1330	TSM	3 m shoreward of T4
	T2[1]	1330-1335	(2 pair)	3 m shoreward of T5
	T4[1]	1325-1330		At breakers
	T5[1]	1325-1330		At breakers
	T6[1]	1335-1340		3 m shoreward of T7
	T7[1]	1335-1340		At breakers
	CM2, PG2[1]	1325-1340		Downdrift and opposite T1, T2, T6
	CM3, PG3[1]	1325-1340		Downdrift and opposite T4, T5, T7
8809191355	T3 & OBS[1]	1355-1405	COM	Surf zone (OBS mounted on T3)
	CM2, PG2[1]	1355-1405[2]		Downdrift and opposite T3
	CM3, PG3[1]	1355-1405[2]		Downdrift and opposite T3
8809191540	T1[1]	1540-1545	TSM	3 m shoreward of T4
	T2[1]	1545-1550	(2 pair)	3 m shoreward of T5
	T4[1]	1540-1545		Surf zone
	T5[1]	1545-1550		Surf zone
	T6[1]	1550-1555		3 m shoreward of T7
	T7[1]	1550-1555		Surf zone
	CM2, PG2[1]	1540-1555		Downdrift and opposite T4, T5, T7
	CM3, PG3[1]	1540-1555		At breakers
8809191610	T3 & OBS[1]	1610-1615	COM	Surf zone (OBS mounted on T3)
	CM2, PG2[1]			Downdrift and opposite T3
	CM3, PG3[1]			Downdrift and opposite T3
8809191645	T3 & OBS[1]	1645-1650	COM	Surf zone (OBS mounted on T3)
	CM2, PG2[1]			Downdrift and opposite T3
	CM3, PG3[1]			Downdrift and opposite T3
8809191715	T3 & OBS[1]	1715-1720	COM	Surf zone (OBS mounted on T3)
	CM2, PG2[1]			Downdrift and opposite T3
	CM3, PG3[1]			Downdrift and opposite T3

(Continued) (Sheet 3 of 4)

[1] Positioned in surf zone.
[2] Some gaps exist in data set.

Table B1 (Concluded)

Run ID No.	Instrument	Time EDST	Type of Run	Description of Deployment Location
8809211105	T1[1]	1105-1110	TSM	At breakers
	T2[1]	1110-1115	(1 pair)	
	T3 & OBS[1]	1115-1120	and COM	
	T4[1]	1120-1125		
	T5[1]	1125-1130		
	T6[1]	1130-1135		
	T7[1]	1135-1140		
	CM2, PG2[1]	1105-1140		Downdrift and opposite traps
	CM3, PG3	1105-1140		Downdrift and opposite traps
8809211345	T1[1]	1415-1420	TSM	At breakers
	T2[1]	1345-1350	(1 pair)	
	T3 & OBS[1]	1350-1355	and COM	
	T4[1]	1355-1400		
	T5[1]	1400-1405		
	T6[1]	1405-1410		
	T7[1]	1410-1415		
	CM2, PG2[1]	1347-1420		Downdrift and opposite traps
	CM3, PG3	1347-1420		Downdrift and opposite traps
8809211435	T3 & OBS[1]	1435-1440	COM	Surf zone (OBS mounted on T3)
	CM2, PG2[1]			Downdrift and opposite T3
	CM3, PG3[1]			Downdrift and opposite T3
8809211520	T1[1]	1520-1525	SSM	37.0 m from baseline
	T2		and COM	41.3 m from baseline
	T3 & OBS			45.1 m from baseline
	T4			49.7 m from baseline
	T5			53.9 m from baseline
	T6			57.6 m from baseline
	T7			60.7 m from baseline
	CM2, PG2	1521-1525		45.1 m from baseline
	CM3, PG3	1521-1525		54.0 m from baseline

[1] Positioned in surf zone.

(Sheet 4 of 4)

Table B2

LUDINGTON: Sand Wet Weights, g

Trap No.	Streamer Number[1] 1	2	3	4	5
			Run 8809141550		
1	469.0	76.1	29.7	17.3	6.8
2	61.4	17.6	24.2	18.6	5.8
			Run 8809141610		
3	421.4	92.4	29.0	11.4	8.2
			Run 8809161625		
1	48.0	116.3	122.0	37.7	17.7
2	64.3	36.5	26.9	14.8	4.6
3	167.3	291.6	138.8	0.0	25.6
4	39.8	15.0	21.2	6.4	6.4
5	141.0	160.3	172.0	55.1	17.5
6	51.9	44.4	21.6	3.0	8.4
7	86.5	111.6	136.2	35.9	8.4
			Run 8809161725		
1	262.5	223.6	156.0	22.8	9.9
2	249.7	180.8	143.5	23.3	10.5
3	146.4	213.6	146.0	42.8	13.5
4	45.6	33.4	32.7	15.2	4.6
			Run 8809171130		
1	1305.0	598.3	27.0	4.8	10.0
2	1403.7	689.3	242.1	51.4	2.0
3	124.6	160.7	79.1	61.9	16.4
4	14.3	8.0	6.0	4.1	11.9
5	47.3	10.6	3.3	3.3	9.1
6	25.4	8.3	17.5	4.3	4.9
7	63.2	15.2	5.6	8.4	3.5
			Run 8809171521		
1	105.7[2]	13.9[2]	8.5[2]	4.5[2]	6.8[2]
2	34.3	5.4	3.9	14.1	2.8
3	181.2	10.6	7.4	0.0	6.5
4	133.1	48.0	4.0	0.0	0.0
5	127.5	5.5	4.9	7.9	0.0
6	18.9	9.6	3.1	8.8	0.0
7	112.3	6.0	4.7	0.0	0.0

(Continued)

[1] Unless otherwise indicated, SD nozzles were used.
[2] C nozzle used.

(Sheet 1 of 3)

Table B2 (Continued)

Trap No.	Streamer Number[1] 1	2	3	4	5
	Run 8809181525				
1	22.2[2]	0.8[2]	1.8[2]	0.4[2]	0.5[2]
2	22.5	9.6	5.6	3.7	6.0
3	50.6	5.1	0.6	3.0	1.7
4	89.6	21.5	13.1	15.4	12.6
5	72.1	54.3	10.1	6.6	3.6
6	191.2	7.7	16.3	3.6	3.7
7	116.2	13.5	5.0	1.9	3.3
8	3.2[2]	15.2[2]	1.6[2]	0.0[2]	0.0[2]
	Run 8809181645				
1	24.8[2]	4.2[2]	3.9[2]	1.6[2]	1.6[2]
2	160.2	55.4	71.5	12.3	6.4
3	99.0	0.0	4.9	2.6	3.2
4	150.7	94.0	81.2	15.3	5.5
5	110.7	11.3	6.6	4.9	4.5
6	105.1	136.0	35.3	8.4	5.4
7	24.8	11.9	6.2	5.2	0.0
8	25.3[2]	5.5[2]	7.0[2]	5.3[2]	2.6[2]
	Run 8809191325				
1	63.8[2]	52.3[2]	62.2[2]	49.9[2]	10.4[2]
2	612.1[3]	1032.7[3]	544.2[3]	46.1	6.6
4	180.6	302.2	197.9	89.8	12.3
5	205.3	618.0	303.6	94.0	7.0
6	318.6	411.6	93.4	10.5	0.0
7	226.7	416.7	237.2	52.0	6.3
	Run 8809191355				
3	325.7	273.2	146.2	77.6	20.9
	Run 8809191540				
1	47.7[2]	32.4[2]	20.4[2]	12.4[2]	1.1[2]
2	541.1[3]	647.7[3]	336.4[3]	31.4	12.0
4	72.8	52.8	44.5	23.2	3.8
5	753.2	217.1	134.5	48.4	6.2
6	88.8	389.7	219.4	33.9	7.6
7	118.3	330.9	212.2	60.8	11.2

(Continued)

[1] Unless otherwise indicated, SD nozzles were used.
[2] C nozzle used.
[3] D85 nozzle used.

(Sheet 2 of 3)

Table B2 (Concluded)

Trap No.	Streamer Number[1]				
	1	2	3	4	5
		Run 8809191610			
3	194.9	122.3	91.7	28.0	9.6
		Run 8809191645			
1	157.1	74.9	21.1	14.3	11.6
		Run 8809191715			
1	133.5	48.9	15.6	5.4	4.8
		Run 8809211105			
1	6.3[2]	0.0[2]	6.3[2]	7.0[2]	4.8[2]
2	237.7	44.6	54.2	46.1	11.5
3	120.3	49.0	32.9	16.7	6.2
4	93.8	19.6	12.9	9.5	7.3
5	550.9	51.7	22.5	20.8	3.4
6	46.1	52.1	37.3	19.7	5.3
7	316.2	39.3	19.8	14.3	6.9
		Run 8809211345			
1	330.6[2]	127.6[2]	110.0[2]	20.0[2]	3.9[2]
2	1281.9	505.2	279.5	30.0	1.6
3	392.9	712.2	367.7	0.0	14.8
4	409.8	314.8	236.0	61.0	35.2
5	758.7	241.3	187.1	51.8	3.6
6	1003.4	763.4	231.8	3.1	1.9
7	236.6	423.8	225.0	59.1	0.0
		Run 8809211435			
1	627.2	293.6	105.9	42.7	6.9
		Run 8809211520			
1	1454.5[2]	621.4[2]	258.5[2]	5.4[2]	0.0[2]
2	517.1	116.1	42.6	17.3	3.2
3	57.8	24.3	7.2	8.6	10.8
4	6.9	4.7	6.4	2.2	0.0
5	59.9	10.3	4.7	1.9	0.0
6	62.3	5.3	4.7	5.4	0.0
7	93.6	7.9	7.8	0.5	0.0

[1] Unless otherwise indicated, SD nozzles were used.
[2] C nozzle used.

(Sheet 3 of 3)

Table B3

LUDINGTON: Streamer Elevations from Sea Bed to Mid-Streamer, m

Trap No.	Streamer Number 1	2	3	4	5
		Run 8809141550			
1	0.013	0.097	0.225	0.441	0.660
2	0.013	0.118	0.276	0.494	0.722
		Run 8809141610			
3	0.013	0.095	0.224	0.435	0.656
		Run 8809161625			
1	0.013	0.097	0.225	0.422	0.635
2	0.013	0.118	0.276	0.494	0.722
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.079	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.112	0.254	0.453	0.732
		Run 8809161725			
1	0.013	0.097	0.225	0.422	0.635
2	0.013	0.118	0.276	0.494	0.722
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.205	[illegible]	0.722
		Run 8809171130			
1	0.013	0.097	0.225	[illegible]	0.635
2	0.013	0.118	0.276	[illegible]	0.722
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.079	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.453	0.732
		Run 8809171521			
1	0.026	0.103	0.203	0.432	0.663
2	0.013	0.118	0.276	0.494	0.722
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.067	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.452	0.732

(Continued) (Sheet 1 of 3)

Table B3 (Continued)

Trap No.	Streamer Number 1	2	3	4	5
		Run 8809181525			
1	0.026	0.103	0.203	0.432	0.663
2	0.013	0.118	0.276	0.494	0.722
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.067	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.452	0.732
8	0.026	0.103	0.203	0.432	0.663
		Run 8809181645			
1	0.026	0.103	0.203	0.432	0.663
2	0.013	0.118	0.276	0.494	0.722
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.067	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.452	0.732
8	0.026	0.103	0.203	0.432	0.663
		Run 8809191325			
1	0.026	0.103	0.203	0.432	0.663
2	0.045	0.172	0.326	0.515	0.747
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.067	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.452	0.732
		Run 8809191355			
3	0.013	0.095	0.224	0.435	0.656
		Run 8809191540			
1	0.026	0.103	0.203	0.432	0.663
2	0.045	0.172	0.326	0.515	0.747
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.067	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.452	0.732

(Continued)

(Sheet 2 of 3)

Table B3 (Concluded)

Trap No.	Streamer Number 1	2	3	4	5
		Run 8809191610			
3	0.013	0.095	0.224	0.435	0.656
		Run 8809191645			
1	0.013	0.095	0.224	0.435	0.656
		Run 8809191715			
1	0.013	0.095	0.224	0.435	0.656
		Run 8809211105			
1	0.026	0.103	0.203	0.432	0.663
2	0.013	0.094	0.235	0.470	0.686
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.067	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.452	0.732
		Run 8809211345			
1	0.026	0.103	0.203	0.432	0.663
2	0.013	0.094	0.235	0[illegible]70	0.686
3	0.013	0.095	0.224	0.[illegible]35	0.656
4	0.013	0.079	0.225	0.[illegible]46	0.718
5	0.013	0.067	0.205	0.[illegible]9	0.722
6	0.013	0.118	0.322	0.[illegible]5	0.967
7	0.013	0.113	0.254	0.[illegible]	0.732
		Run 8809211435			
1	0.013	0.095	0.224	0.435	0.656
		Run 8809211520			
1	0.026	0.103	0.203	0.432	0.663
2	0.013	0.094	0.235	0.470	0.686
3	0.013	0.095	0.224	0.435	0.656
4	0.013	0.079	0.225	0.446	0.718
5	0.013	0.067	0.205	0.429	0.722
6	0.013	0.118	0.322	0.616	0.967
7	0.013	0.113	0.254	0.452	0.732

(Sheet 3 of 3)

Table B4

LUDINGTON: Water Levels

Time EST[1]		Water Level m, IGLD[2]
	Run 8809141550	
1500		176.309
1600		176.312
	Run 8809161625	
1600		176.251
1700		176.284
	Run 8809161725	
1700		176.284
1800		176.324
	Run 8809171130	
1100		176.299
1200		176.318
	Run 8809171430	
1400		176.312
1500		176.318
	Run 8809171521	
1500		176.318
1600		176.333
	Run 8809171710	
1700		176.324
1800		176.287
	Run 8809181525	
1500		176.278
1600		176.287
	Run 8809181645	
1600		176.287
1700		176.376
	Run 8809191325	
1300		176.302
1400		176.302

(Continued)

(Sheet 1 of 2)

[1] Eastern Standard Time.
[2] IGLD = International Great Lakes Datum (175.8 m IGLD = Low Water Datum (LWD)).

Table B4 (Concluded)

Time EST		Water Level m, IGLD
	Run 8809191540	
1500		176.376
1600		176.302
	Run 8809191645	
1600		176.302
1700		176.348
	Run 8809191715	
1700		176.348
1800		176.409
	Run 8809211105	
1100		176.275
1200		176.257
	Run 8809211345	
1300		176.257
1400		176.245
	Run 8809211435	
1400		176.245
1500		176.293
	Run 8809211520	
1500		176.293
1600		176.333

(Sheet 2 of 2)

Table B5

LUDINGTON: Current Meter Data

Time EDST[2]	Current Speed, cm/sec							
	CY2[1]		CX2		CY3		CX3	
	Mean	σ_v	Mean	σ_v	Mean	σ_v	Mean	σ_v
			Run 8809141550					
1550-1555	8.7	23.9	6.9	32.1	-1.9	23.8	4.3	33.7
			Run 8809141610					
1610-1615	9.1	24.0	6.0	33.2	-1.2	24.0	6.7	33.2
			Run 8809141625					
1625-1630	-15.8	38.4	9.3	47.1	-6.8	43.5	22.9	45.7
1630-1635	-16.8	40.7	11.7	51.4	-6.9	44.3	27.0	47.7
1635-1640	-19.0	34.4	8.4	46.5	-9.9	45.6	23.5	43.3
			Run 8809161725					
1725-1730	-15.9	34.7	4.2	45.0	-10.4	47.4	11.9	42.8
			Run 8809171130					
1130-1135	-9.7	113.2	7.8	117.0	-8.1	104.1	8.2	97.9
			Run 8809171521					
1521-1526	-11.0	47.9	0.3	53.1	0.7	51.3	1.7	49.0
			Run 8809181525					
1525-1530	-5.1	42.0	7.9	52.0	-5.9	44.1	4.7	49.7
1530-1532	2.8	35.7	13.2	45.3	-7.6	49.2	5.3	41.4
1534-1535	-5.7	38.3	7.9	54.3	-3.8	48.2	2.1	48.9
1535-1540	-3.7	39.8	11.3	55.6	-6.2	42.8	8.5	50.4
1540-1545	-2.5	39.9	7.3	51.2	-5.6	41.5	6.2	46.2
1545-1550	-2.0	40.2	7.6	50.2	-2.8	40.6	4.5	44.6

(Continued)

[1] Notation is defined in Appendix C.
[2] Eastern Daylight Savings Time.

(Sheet 1 of 3)

Table B5 (Continued)

Time EDST	Current Speed, cm/sec							
	CY2		CX2		CY3		CX3	
	Mean	σ_v	Mean	σ_v	Mean	σ_v	Mean	σ_v
				Run 8809181645				
1650-1655	-11.0	40.5	10.4	48.9	-5.1	34.6	11.2	36.5
1655-1700	-9.5	38.8	11.2	48.4	-5.5	35.6	9.6	39.1
1700-1702	-9.7	34.1	4.6	43.7	-7.4	33.1	4.7	36.7
1710-1715	-12.1	40.2	9.1	49.0	-5.7	40.2	7.1	41.7
				Run 8809191325				
1325-1330	-35.6	39.6	16.5	61.4	-38.6	38.1	16.0	46.6
1330-1335	-10.5	40.3	20.2	65.9	-15.0	41.3	12.9	49.2
1335-1340	-30.3	38.5	15.8	62.8	-36.2	39.7	9.6	46.0
				Run 8809191355				
1355-1356	-43.0	46.1	8.9	73.2	-36.0	41.4	17.7	45.4
1358-1405	-25.2	40.5	20.7	60.3	-31.5	40.1	16.8	48.1
				Run 8809191540				
1540-1545	-26.2	38.9	6.8	54.8	-29.5	38.8	9.3	46.1
1545-1550	-28.9	36.9	13.7	55.8	-32.6	39.9	18.0	42.2
1550-1555	-26.5	38.5	13.8	57.6	-20.3	41.6	17.1	47.7
				Run 8809191610				
1610-1615	-26.2	42.0	17.9	57.4	-29.0	41.1	17.0	49.1
				Run 8809191645				
1645-1650	-12.9	38.5	21.7	67.6	-21.1	40.3	9.1	47.7
				Run 8809191715				
1715-1720	-9.8	38.4	22.2	58.1	-13.8	40.8	14.3	43.8

(Continued)

(Sheet 2 of 3)

Table B5 (Concluded)

Time EDST	Current Speed, cm/sec CY2 Mean	CY2 σ_v	CX2 Mean	CX2 σ_v	CY3 Mean	CY3 σ_v	CX3 Mean	CX3 σ_v
				Run 8809211105				
1105-1110	2.5	31.2	7.8	32.1	-13.0	48.7	10.9	45.6
1110-1115	6.1	32.7	7.9	30.9	-15.6	49.4	5.0	40.4
1115-1120	10.0	31.0	8.8	32.7	-7.7	52.6	3.5	46.1
1120-1125	15.5	31.5	11.6	31.8	-12.4	50.4	4.6	42.5
1130-1135	9.2	32.3	12.6	32.3	-13.0	44.7	3.7	39.1
1135-1140	8.8	30.8	8.7	33.5	-14.9	46.8	2.3	40.8
				Run 8809211345				
1347-1350	40.5	32.5	19.2	43.5	8.9	43.1	3.2	41.0
1350-1355	19.7	37.1	7.2	46.6	7.7	38.3	5.1	40.8
1355-1400	26.3	33.0	11.5	45.7	1.5	37.0	1.5	41.6
1400-1405	27.5	31.9	14.3	43.3	4.9	40.0	1.0	39.0
1405-1410	23.5	40.1	4.1	50.0	6.1	39.1	1.4	40.1
1410-1415	26.7	32.5	9.5	45.6	8.4	37.3	2.7	39.3
1415-1420	25.9	34.6	8.5	43.1	5.0	37.3	-0.9	39.2
				Run 8809211435				
1435-1440	24.9	37.0	11.1	48.0	6.9	40.0	4.2	42.2
				Run 8809211520				
1521-1525	2.5	36.3	3.0	39.5	3.8	45.6	1.6	41.4
				Run 8809211740				
1740-1805	11.2	40.8	7.6	43.1	7.7	46.2	1.4	45.6

(Sheet 3 of 3)

Table B6

LUDINGTON: Wave Data

Run ID	Gage No.	Averaging Interval EDST[2]	$\bar{H}$[1] m	σ_H m	H_{rms} m	$H_{1/3}$ m	$H_{1/10}$ m	H_{max} m	$\bar{T}$ sec	σ_T sec	T_{rms} sec	$T_{1/3}$ sec	$T_{1/10}$ sec	T_{max} sec
8809141550	2	1550 - 1555	0.26	0.097	0.28	0.36	0.39	0.43	3.9	1.06	4.0	5.1	6.0	6.4
	3	1550 - 1555	0.28	0.102	0.30	0.39	0.43	0.49	3.9	1.07	4.1	5.0	5.7	6.2
8809141610	2	1610 - 1615	0.26	0.108	0.28	0.37	0.44	0.48	3.8	1.41	4.0	5.3	6.5	7.6
	3	1610 - 1615	0.24	0.097	0.26	0.35	0.42	0.47	3.6	1.11	3.7	4.8	5.6	6.0
8809161625	1	1625 - 1630	0.27	0.099	0.29	0.38	0.43	0.46	4.4	1.62	4.7	6.2	7.7	9.6
	2	1625 - 1630	0.23	0.105	0.25	0.34	0.40	0.49	4.3	1.59	4.6	6.1	6.8	8.4
	3	1625 - 1630	0.25	0.102	0.27	0.36	0.44	0.60	4.3	1.53	4.5	6.0	6.9	7.6
	1	1630 - 1635	0.28	0.092	0.29	0.38	0.44	0.47	4.7	1.24	4.8	6.0	6.7	7.6
	2	1630 - 1635	0.24	0.105	0.26	0.36	0.40	0.43	4.2	1.53	4.5	5.9	6.9	7.4
	3	1630 - 1635	0.24	0.098	0.26	0.35	0.39	0.40	4.2	1.66	4.5	6.1	7.3	8.6
	1	1635 - 1640	0.25	0.110	0.27	0.33	0.47	0.52	4.5	1.49	4.8	6.3	7.2	7.8
	2	1635 - 1640	0.25	0.096	0.26	0.34	0.40	0.53	4.6	1.58	4.9	6.4	7.2	8.6
	3	1635 - 1640	0.27	0.104	0.29	0.38	0.44	0.47	4.6	1.78	4.9	6.6	7.5	8.8
8809161725	2	1725 - 1730	0.20	0.092	0.22	0.30	0.38	0.43	4.6	1.65	4.9	6.4	7.2	8.2
	3	1725 - 1730	0.25	0.113	0.27	0.37	0.48	0.54	5.0	1.91	5.4	7.1	8.5	10.8
8809171130	1	1130 - 1135	0.18	0.078	0.20	0.26	0.33	0.42	3.8	1.23	4.0	5.1	5.7	6.6
	2	1130 - 1135	0.20	0.083	0.22	0.30	0.33	0.37	3.8	1.17	4.0	5.1	6.0	6.8
	3	1130 - 1135	0.23	0.068	0.24	0.30	0.36	0.44	4.1	1.15	4.3	5.4	6.2	8.4
8809171521	1	1521 - 1526	0.24	0.141	0.27	0.37	0.55	0.85	3.9	1.41	4.1	5.5	6.7	8.4
	2	1521 - 1526	0.23	0.098	0.25	0.34	0.43	0.54	4.0	1.21	4.2	5.4	6.2	7.0
	3	1521 - 1526	0.23	0.127	0.26	0.36	0.49	0.80	3.6	1.33	3.9	5.1	6.1	7.0
8809181525	1	1525 - 1530	0.17	0.081	0.19	0.27	0.34	0.42	3.[illegible]	1.23	3.9	5.0	6.4	8.2
	2	1525 - 1530	0.27	0.102	0.28	0.38	0.45	0.53	3[illegible]	1.04	3.8	4.8	5.6	8.0
	3	1525 - 1530	0.21	0.085	0.22	0.29	0.38	0.51	3.[illegible]	0.93	3.7	4.7	5.3	5.6
	1	1530 - 1532	0.14	0.078	0.16	0.22	0.33	0.43	3.[illegible]	1.03	3.5	4.5	5.4	6.4
	2	1530 - 1531	0.32	0.111	0.34	0.43	0.57	0.57	4.[illegible]	1.02	4.1	5.1	5.6	5.6
	3	1530 - 1531	0.25	0.100	0.27	0.37	0.45	0.45	4.[illegible]	1.05	4.1	5.2	5.8	5.8
	1	1534 - 1535	0.17	0.107	0.20	0.31	0.38	0.38	3.6	0.66	3.7	4.3	4.4	4.4
	2	1534 - 1535	0.25	0.130	0.28	0.41	0.50	0.50	3.1	0.60	3.2	3.9	4.0	4.0
	3	1534 - 1535	0.22	0.094	0.24	0.33	0.37	0.37	3.4	0.88	3.5	4.3	5.0	5.0
	1	1535 - 1540	0.17	0.086	0.19	0.26	0.35	0.55	3.7	1.35	3.9	5.2	6.4	10.4
	2	1535 - 1540	0.27	0.101	0.29	0.38	0.45	0.54	3.7	1.07	3.9	4.9	5.7	7.2
	3	1535 - 1540	0.23	0.086	0.24	0.32	0.39	0.43	3.8	1.07	4.0	5.0	6.0	6.6
	1	1540 - 1545	0.15	0.074	0.17	0.23	0.32	0.46	3.6	1.07	3.7	4.7	5.8	7.0
	2	1540 - 1545	0.27	0.104	0.29	0.38	0.46	0.71	3.7	1.03	3.9	4.9	5.6	6.6
	3	1540 - 1545	0.22	0.098	0.24	0.32	0.41	0.69	3.6	0.93	3.7	4.6	5.1	5.4
	1	1545 - 1550	0.15	0.068	0.17	0.23	0.28	0.38	3.2	0.91	3.3	4.2	5.0	5.8
	2	1545 - 1550	0.24	0.081	0.25	0.33	0.38	0.42	3.7	1.01	3.8	4.9	5.7	7.0
	3	1545 - 1550	0.20	0.101	0.23	0.32	0.41	0.50	3.5	0.98	3.6	4.6	5.5	6.6
8809181645	1	1650 - 1655	0.18	0.103	0.20	0.29	0.39	0.64	3.4	0.98	3.5	4.4	5.1	6.2
	2	1650 - 1655	0.23	0.090	0.25	0.33	0.39	0.44	3.6	0.88	3.7	4.5	5.0	6.0
	3	1650 - 1655	0.21	0.084	0.22	0.30	0.35	0.42	3.5	0.89	3.6	4.5	5.2	6.0
	1	1655 - 1700	0.15	0.077	0.17	0.24	0.31	0.41	3.4	0.86	3.5	4.4	4.9	5.2
	2	1655 - 1700	0.23	0.095	0.24	0.34	0.40	0.45	3.4	0.96	3.6	4.4	5.1	7.4
	3	1655 - 1700	0.22	0.093	0.24	0.33	0.40	0.43	3.4	0.89	3.5	4.3	5.0	6.8
	1	1700 - 1705	0.15	0.093	0.18	0.25	0.37	0.53	3.5	0.99	3.6	4.5	5.6	6.8
	2	1700 - 1701	0.15	0.079	0.17	0.24	0.29	0.29	3.3	0.92	3.4	4.3	4.6	4.6
	3	1700 - 1701	0.14	0.080	0.16	0.23	0.28	0.28	3.2	0.77	3.3	4.1	4.4	4.4
	1	1705 - 1709	0.15	0.074	0.17	0.24	0.32	0.40	3.5	0.80	3.6	4.4	5.0	5.4
	2	1710 - 1715	0.20	0.078	0.22	0.29	0.34	0.40	3.5	1.08	3.7	4.7	5.8	8.4
	3	1710 - 1715	0.20	0.091	0.22	0.30	0.37	0.48	3.4	0.91	3.5	4.4	5.1	6.0

(Continued)

[1] Notation is defined in Appendix C.
[2] Eastern Daylight Savings Time.

(Sheet 1 of 2)

Table B6 (Concluded)

Run ID	Gage No.	Averaging Interval EDST	$\bar{H}$ m	σ_H m	H_{rms} m	$H_{1/3}$ m	$H_{1/10}$ m	H_{max} m	$\bar{T}$ sec	σ_T sec	T_{rms} sec	$T_{1/3}$ sec	$T_{1/10}$ sec	T_{max} sec
8809191325	2	1325 - 1330	0.31	0.140	0.34	0.46	0.58	0.71	4.3	1.79	4.7	6.4	7.9	10.2
	3	1325 - 1330	0.28	0.126	0.30	0.41	0.52	0.66	4.2	1.73	4.5	6.3	7.5	9.0
	2	1330 - 1335	0.34	0.151	0.37	0.51	0.62	0.86	4.8	1.92	5.1	7.1	8.5	9.4
	3	1330 - 1335	0.29	0.143	0.32	0.46	0.54	0.62	4.4	1.85	4.8	6.6	8.1	9.4
	2	1335 - 1340	0.31	0.144	0.35	0.48	0.58	0.64	4.4	2.09	4.9	6.9	8.6	9.8
	3	1335 - 1340	0.28	0.146	0.32	0.46	0.585	0.61	4.4	1.91	4.8	6.7	8.0	8.8
8809191355	2	1358 - 1405	0.32	0.128	0.34	0.46	0.53	0.59	4.5	1.81	4.8	6.5	7.6	8.6
	3	1358 - 1405	0.29	0.141	0.32	0.44	0.56	0.71	4.4	1.65	4.7	6.2	7.6	9.0
8809191540	2	1540 - 1545	0.31	0.143	0.34	0.46	0.55	0.85	4.5	2.00	4.9	6.9	8.2	9.2
	3	1540 - 1545	0.31	0.135	0.33	0.47	0.55	0.60	4.7	2.16	5.2	7.4	8.9	10.0
	2	1545 - 1550	0.33	0.135	0.36	0.48	0.54	0.58	4.8	1.89	5.1	6.8	8.2	9.4
	3	1545 - 1550	0.27	0.139	0.31	0.43	0.53	0.76	4.1	1.93	4.5	6.4	7.9	9.6
	2	1550 - 1555	0.34	0.147	0.37	0.50	0.62	0.75	4.7	2.09	5.2	7.3	8.8	9.6
	3	1550 - 1555	0.31	0.130	0.33	0.45	0.54	0.58	4.3	1.81	4.7	6.5	8.1	8.8
8809191610	2	1610 - 1615	0.35	0.141	0.38	0.51	0.57	0.65	4.8	2.01	5.2	7.2	8.3	10.0
	3	1610 - 1615	0.29	0.124	0.32	0.43	0.54	0.69	4.3	1.81	4.7	6.5	8.0	10.2
8809191645	2	1645 - 1650	0.32	0.124	0.34	0.47	0.54	0.57	4.6	2.05	5.0	7.1	8.2	9.2
	3	1645 - 1650	0.31	0.149	0.35	0.48	0.59	0.67	4.5	2.13	5.0	7.0	9.1	11.2
8809191715	2	1715 - 1720	0.30	0.133	0.33	0.45	0.52	0.55	4.5	2.47	5.1	7.4	9.8	13.0
	3	1715 - 1720	0.30	0.133	0.33	0.46	0.52	0.60	5.0	2.51	5.6	8.0	10.1	13.8
8809211105	2	1105 - 1110	0.21	0.083	0.23	0.30	0.36	0.42	3.7	1.29	3.9	5.2	6.5	7.8
	3	1105 - 1110	0.21	0.089	0.23	0.32	0.39	0.47	3.5	1.04	3.6	4.6	5.5	6.4
	2	1110 - 1115	0.22	0.086	0.24	0.32	0.37	0.42	4.0	1.36	4.2	5.5	6.9	8.0
	3	1110 - 1115	0.22	0.092	0.24	0.32	0.38	0.47	3.8	1.35	4.1	5.3	6.7	8.8
	2	1115 - 1120	0.22	0.082	0.23	0.31	0.37	0.41	3.9	1.39	4.2	5.5	6.9	8.6
	3	1115 - 1120	0.20	0.074	0.21	0.28	0.34	0.47	3.7	1.44	4.0	5.3	7.1	8.8
	2	1120 - 1125	0.22	0.082	0.23	0.30	0.37	0.60	3.8	1.14	3.9	5.0	6.1	8.6
	3	1120 - 1125	0.20	0.081	0.22	0.29	0.34	0.42	3.5	1.32	3.7	4.8	6.2	11.4
	2	1125 - 1130	0.21	0.078	0.23	0.30	0.36	0.39	3.9	1.41	4.2	5.5	7.2	8.8
	3	1125 - 1130	0.21	0.076	0.22	0.29	0.33	0.39	3.6	1.35	3.8	5.1	6.5	8.8
	2	1130 - 1135	0.20	0.108	0.22	0.31	0.43	0.76	3.4	1.20	3.6	4.8	5.9	6.6
	3	1130 - 1135	0.19	0.086	0.21	0.28	0.36	0.51	3.6	1.49	3.9	5.2	6.9	9.8
	2	1135 - 1140	0.21	0.084	0.22	0.30	0.34	0.40	3.6	1.35	3.8	5.1	6.3	8.6
	3	1135 - 1140	0.20	0.098	0.22	0.29	0.40	0.64	3.5	1.33	3.7	5.0	6.4	8.4
8809211345	2	1347 - 1350	0.20	0.064	0.21	0.27	0.32	0.40	3.8	1.32	4.0	5.4	6.4	7.2
	3	1347 - 1350	0.19	0.066	0.20	0.26	0.32	0.34	3.9	1.30	4.1	5.4	6.5	7.4
	2	1350 - 1355	0.21	0.078	0.23	0.29	0.36	0.43	3.7	1.20	3.9	5.1	6.1	7.0
	3	1350 - 1355	0.20	0.067	0.21	0.27	0.32	0.35	3.8	1.15	3.9	5.1	5.9	6.6
	2	1355 - 1400	0.23	0.108	0.26	0.33	0.46	0.74	3.7	1.18	3.9	5.0	5.6	6.8
	3	1355 - 1400	0.22	0.080	0.23	0.31	0.37	0.44	3.8	1.27	4.0	5.2	6.0	6.6
	2	1400 - 1405	0.20	0.075	0.21	0.29	0.33	0.40	3.5	1.23	3.7	4.9	6.0	7.0
	3	1400 - 1405	0.21	0.074	0.22	0.28	0.32	0.35	3.9	1.40	4.1	5.4	6.3	7.8
	2	1405 - 1410	0.22	0.094	0.24	0.31	0.39	0.57	3.6	1.25	3.8	4.9	5.9	7.2
	3	1405 - 1410	0.21	0.085	0.23	0.30	0.37	0.51	3.9	1.23	4.0	5.2	5.8	6.4
	2	1410 - 1415	0.21	0.075	0.23	0.29	0.34	0.45	3.6	1.23	3.8	5.0	6.1	7.0
	3	1410 - 1415	0.20	0.076	0.21	0.28	0.33	0.44	3.7	1.18	3.9	5.0	5.6	6.8
	2	1415 - 1420	0.19	0.074	0.21	0.28	0.32	0.37	3.5	1.15	3.7	4.8	5.7	7.6
	3	1415 - 1420	0.17	0.072	0.19	0.25	0.29	0.31	3.4	1.04	3.6	4.6	5.2	6.0
8809211435	2	1435 - 1440	0.22	0.080	0.23	0.30	0.38	0.48	3.9	1.24	4.1	5.3	6.1	7.2
	3	1435 - 1440	0.21	0.079	0.23	0.29	0.35	0.44	3.7	1.18	3.8	5.0	5.6	5.8
8809211520	2	1521 - 1525	0.19	0.072	0.20	0.27	0.32	0.47	3.8	1.30	4.0	5.3	6.0	6.6
	3	1521 - 1525	0.21	0.073	0.22	0.29	0.33	0.38	4.1	1.19	4.2	5.3	6.1	6.8

(Sheet 2 of 2)

Table B7

LUDINGTON: Profile Survey Data

Profile Line No.	Distance from Baseline, m	Elevation m LWD[1]
	September 14[2]	
22[3]	0.0	1.89
	3.0	1.46
	6.1	1.34
	9.1	1.34
	12.2	1.28
	15.2	1.19
	18.3	1.13
	21.3	1.07
	24.4	0.58
	27.4	0.24
	30.5	0.15
	33.5	0.03
	36.6	-0.09
	39.6	-0.27
	42.7	-0.40
	45.7	-0.52
	48.8	-0.61
	51.8	-0.67
	54.9	-0.70
	57.9	-0.76
	61.0	-0.76
	64.0	-0.76
	67.1	-0.70
	70.1	-0.67
	73.2	-0.64
	76.2	-0.58
	79.3	-0.58
	82.3	-0.58
	85.4	-0.58
	88.4	-0.49
	91.4	-0.46
	94.5	-0.46
	97.5	-0.52

(Continued)

[1] LWD = Low Water Datum.
[2] Traps positioned approximately halfway between profile lines 22 and 24 on 14 September.
[3] Profile line 22 intersects the baseline at state plane coordinates 91,121.0 m East and 285,268.4 m North, and is directed offshore at an azimuth 270° 14' 31'' from North.

(Sheet 1 of 4)

Table B7 (Continued)

Profile Line No.	Distance from Baseline, m	Elevation m LWD
	September 14	
24[1]	0.0	1.80
	3.0	1.52
	6.1	1.34
	9.1	1.16
	12.2	1.07
	15.2	1.04
	18.3	0.98
	21.3	0.18
	24.4	0.24
	27.4	0.15
	30.5	0.00
	33.5	-0.15
	36.6	-0.34
	39.6	-0.46
	42.7	-0.61
	45.7	-0.73
	48.8	-0.82
	51.8	-0.98
	54.9	-1.04
	September 16[2]	
23[3]	0.0	-
	3.0	-
	6.1	-
	9.1	-
	12.2	-
	15.2	1.13
	18.3	1.04
	21.3	0.73
	24.4	0.37
	27.4	0.09
	30.5	-0.09

(Continued)

[1] Profile line 24 intersects the baseline at state plane coordinates 91,121.1 m East and 285,298.9 m North, and is directed offshore at an azimuth 270° 14' 31'' from North.
[2] Traps positioned at profile line indicated for succeeding dates.
[3] Profile line 23 intersects the baseline at state plane coordinates 91,121.1 m East and 285,283.6 m North, and is directed offshore at an azimuth 270° 14' 31'' from North.

(Sheet 2 of 4)

Table B7 (Continued)

Profile Line No.	Distance from Baseline, m	Elevation m LWD
	September 17	
	33.5	-0.24
	36.6	-0.34
	39.6	-0.46
	42.7	-0.55
	45.7	-0.64
	48.8	-0.73
	51.8	-0.79
23	0.0	1.62
	3.0	1.37
	6.1	1.34
	9.1	1.37
	12.2	1.31
	15.2	1.13
	18.3	1.10
	21.3	1.07
	24.4	1.07
	27.4	0.61
	30.5	0.27
	33.5	0.09
	36.6	-0.27
	39.6	-0.46
	42.7	-0.55
	45.7	-0.67
	48.8	-0.73
	September 18	
23	0.0	-
	3.0	-
	6.1	-
	9.1	-
	12.2	-
	15.2	1.10
	18.3	1.07
	21.3	1.04
	24.4	1.07
	27.4	0.98
	30.5	0.61
	33.5	0.24
	36.6	0.03

(Continued) (Sheet 3 of 4)

Table B7 (Concluded)

Profile Line No.	Distance from Baseline, m	Elevation m LWD
	39.6	-0.40
	42.7	-0.58
	45.7	-0.67
	September 21	
20[1]	0.0	2.07
	3.0	1.77
	6.1	1.52
	9.1	1.37
	12.2	1.37
	15.2	1.31
	18.3	1.37
	21.3	1.40
	24.4	1.49
	27.4	1.46
	30.5	0.98
	33.5	0.55
	36.6	0.30
	39.6	0.09
	42.7	-0.03
	45.7	-0.46
	48.8	-0.58
	51.8	-0.67
	54.9	-0.67
	57.9	-0.70
	61.0	-0.67

[1] Profile line 20 intersects the baseline at state plane coordinates 91,120.9 m East and 285,237.9 m North, and is directed offshore at an azimuth 270° 14' 31'' from North. (Sheet 4 of 4)

Table B8

LUDINGTON: Grain Size Statistics

Run ID and Trap No.	Streamer No.	Moment Statistics First PHI	Second PHI	Third	Fourth	Folk Inclusive Graphic Statistics Median PHI	Mean PHI	Standard Deviation PHI	Skewness	Kurtosis
8809181525										
3	1	1.61	0.30	0.18	4.69	1.62	1.62	0.30	-0.06	1.07
	2	1.74	0.27	0.03	4.04	1.74	1.74	0.26	0.01	1.05
	3	1.71	0.30	-0.42	3.82	1.72	1.71	0.29	-0.07	1.12
	4	1.58	0.31	-0.08	3.64	1.60	1.59	0.32	-0.07	2.06
	5	1.90	0.47	0.74	4.15	1.85	1.87	0.44	0.21	1.58
8809191355										
3	1	1.55	0.29	-0.41	3.06	1.58	1.56	0.30	-0.13	1.03
	2	1.66	0.25	-0.36	3.95	1.66	1.66	0.25	-0.05	1.10
	3	1.66	0.25	-0.46	3.58	1.67	1.66	0.26	-0.09	1.06
	4	1.68	0.25	-0.42	3.80	1.69	1.69	0.24	-0.05	1.02
	5	1.67	0.26	-0.42	3.59	1.68	1.67	0.26	-0.08	1.06
8809191610										
3	1	1.61	0.26	-0.41	4.61	1.63	1.62	0.26	-0.12	1.16
	2	1.66	0.24	-0.42	4.61	1.66	1.67	0.23	-0.04	1.05
	3	1.67	0.24	-0.39	4.25	1.67	1.68	0.23	-0.03	1.02
	4	1.67	0.25	-0.33	4.59	1.68	1.68	0.24	-0.03	1.02
	5	1.68	0.27	-0.48	5.25	1.69	1.69	0.26	-0.08	1.08
8809191645										
3	1	1.62	0.26	-0.45	3.50	1.64	1.63	0.27	-0.12	1.04
	2	1.69	0.24	-0.37	3.75	1.70	1.70	0.24	-0.05	1.00
	3	1.71	0.24	-0.37	3.74	1.72	1.72	0.23	-0.03	1.03
	4	1.73	0.23	-0.31	3.92	1.74	1.73	0.23	-0.04	1.03
	5	1.71	0.25	-0.41	3.83	1.72	1.73	0.24	-0.03	1.04
8809211105										
3	1	1.48	0.34	-0.28	2.78	1.52	1.48	0.35	-0.18	1.00
	2	1.60	0.31	-0.43	3.19	1.63	1.61	0.31	-0.14	1.01
	3	1.59	0.30	-0.39	3.13	1.61	1.60	0.31	-0.13	0.99
	4	1.62	0.31	-0.42	3.21	1.64	1.62	0.32	-0.12	1.05
	5	1.59	0.31	-0.35	3.40	1.62	1.60	0.32	-0.12	1.03

APPENDIX C: NOTATION

C	Cube nozzle, 5.1 cm high, 5.1 cm wide, 5.1 cm hood
CM1	Current Meter 1
CM2	Current Meter 2
CM3	Current Meter 3
COM	Comparison test between two different closely-spaced devices
CON	Consistency test between two closely-spaced traps
CX1	Cross-shore component of current speed at current meter 1
CX2	Cross-shore component of current speed at current meter 2
CX3	Cross-shore component of current speed at current meter 3
CY1	Longshore component of current speed at current meter 1
CY2	Longshore component of current speed at current meter 2
CY3	Longshore component of current speed at current meter 3
D85	DUCK85 nozzle, 9 cm high, 15 cm wide
$\bar{H}$	Mean wave height, m
H_{max}	Maximum wave height, m
H_{min}	Minimum wave height, m
H_{mo}	Spectrally-based significant wave height, m
H_{rms}	Root-mean-square wave height, m
$H_{1/3}$	Significant wave height, average of the highest one-third wave heights, m
$H_{1/10}$	Average of the highest one-tenth wave heights, m
OBS	Optical Backscatter Sensor
PG1	Pressure Gage 1
PG2	Pressure Gage 2
PG3	Pressure Gage 3
SD	SUPERDUCK nozzle, 2.5 cm high, 15 cm wide, and 5.1 cm hood
SSM	Spatial Sampling Method
$\bar{T}$	Mean wave period, sec
T_{max}	Maximum wave period, sec
T_p	Spectral peak wave period, sec
T_{rms}	Root-mean-square wave period, sec
TSM	Temporal Sampling Method
$T_{1/3}$	Average of the longest one-third wave periods, sec

$T_{1/10}$	Average of the longest one-tenth wave periods, sec
x	Distance offshore, m
y	Distance alongshore, m
σ_H	Standard deviation in wave height, m
σ_T	Standard deviation in wave period, sec
σ_V	Standard deviation in current speed, cm/sec